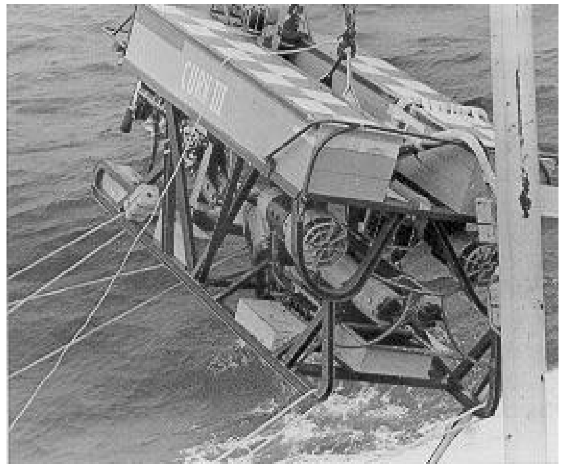


# *MERGER AND NEW MISSIONS: THE NINTEEN SEVENTIES*

## *Introduction*

NUWC had been renamed the Naval Undersea Research and Development Center (NURDC) in 1969 and, by 1970, NURDC had approximately 1400 full-time employees and 370 military personnel. Most of the staff referred to the laboratory as the Naval Undersea Center (NUC), and in 1972, the name was officially changed.

In May 1974, NUC Pasadena was disestablished and its functions and personnel were transferred to NUC headquarters in San Diego. Also in May 1974, NUC dedicated its first new building, the Undersea Weapons Laboratory, a poured-concrete, low-maintenance structure on the waterfront. In September 1976, the building was renamed the William McLean Laboratory in honor of Dr. McLean, the first Technical Director of NUC, who died in 1975, a year after retiring.

Beginning in 1972, NUC updated a sound beacon concept by developing a torpedo-tube-launched, self-propelled decoy. In 1975, NUC was designated lead laboratory for the new Advanced Lightweight Torpedo, later to be designated the Mk 50 torpedo. The laboratory continued to support and enhance the Mk 46 torpedo, which today remains in the Fleet.

Also in the 1970s, the Hawaii laboratory pursued research in marine biosystems and manned and unmanned submersibles and developed the Navy's first Small-Waterplane-Area Twin Hull (SWATH) ship. Beginning in 1974, the Hawaii laboratory performed environmental assessments for several Navy facilities worldwide.

Responsibility for the new field of undersea surveillance was assigned to NUC. Work in undersea surveillance included support of the shore terminals and signal-processing software for the Sound Surveillance Underwater System (SOSUS) and development of the Surveillance Towed Array Sensor System (SURTASS).

As for NELC, by 1970, its employees numbered approximately 1370 civilians and 133 military personnel. In July 1970, a Command Control and Communications Programs Department was established to manage major long-term programs, direct associated system development projects, and establish objectives in supporting technologies. Four major departments were also formed upon which the Programs Department could draw for specialized technical work. These included two technology departments—Electromagnetics Technology and Information Technology—and an Engineering Sciences Department and a Computer Sciences Department. An Administrative and Technical Support Department was also created to provide a coherent internal structure for all activities outside the strictly RDT&E effort.

Over the next several years, NELC pioneered advances in solid-state electronics and digital circuitry, lasers, under-ice sonars, radio physics, ocean research, satellite communications, and ionospheric forecasting.

The year 1977 brought the merger that formed NOSC. NELC and NUC were consolidated as NOSC to provide a broad-spectrum systems capability and to facilitate integration of major mission areas.

## New Facilities

### McLean Laboratory, Building 1, Bayside

In November 1973, construction was completed on NUC's first new building. Dedicated in May 1974 as the Undersea Weapons Laboratory, it was renamed the William McLean Laboratory in September 1976. Located near the waterfront on San Diego Bay, the facility is a five-level, 150,000-square-foot laboratory/shop/office complex for approximately 500 people. The facility continues to support the Center's major roles in integrated ASW and ocean engineering. A major capability within the McLean Laboratory is the performance of hardware-in-the-loop simulation, including both digital and hybrid simulation. The laboratory allows the development and exercise of detailed acoustic models of targets, countermeasures, and operating environments for use in undersea weapon simulations. Building 1 also houses laboratories for ASW data fusion, the development of future guidance and control concepts, materials physics for torpedo electronics applications, and signal processing for ASW tactical surveillance arrays. Vault spaces provide a controlled environment for much of this work. Ocean engineering offices are also located here, and the facility is presently the focus for the broadband local area network that interconnects many host computers.

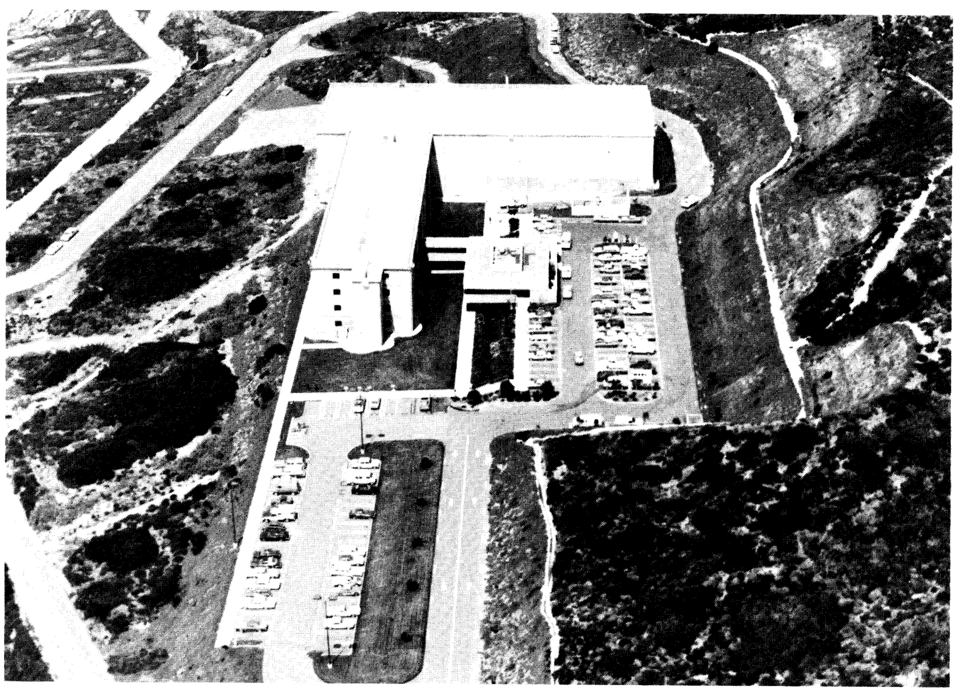
*William McLean Laboratory, Building 1, Bayside.*

## $C^3$ SITE, Building 600, Seaside

To meet the Navy's need for development and integration of emerging tactical command, control, communications, and intelligence systems, NELC completed, in 1976, the Command, Control, and Communication Systems Integration Test and Evaluation ($C^3$ SITE) facility, also known as Building 600, Seaside. Originally called the Electronics Development and Test Laboratory (EDATL), this working facility makes possible, in one secure and electromagnetically shielded location, the solution of problems in a laboratory setting that otherwise would require costly and time-consuming shipboard evaluation. The $C^3$ SITE consists of three contiguous buildings with a total of 55,000 square feet of shielded space. Built below the ridge on the west side of Point Loma, the facility provides ready communications access to the at-sea exercise/operating areas immediately to the west.

### *NURDC/NUC Name Change*

***Captain Charles Bishop, former Commanding Officer of NURDC and later Assistant Director of Engineer Operations at MPL, recalls these events: "When I first came onboard, the name of the Naval Undersea Warfare Center had just been changed to the Naval Undersea Research and Development Center, NURDC. Well, I couldn't stand it. I told people, 'I am not going to be the head of a bunch of nerds.' So it was called the Naval Undersea Center. We kept getting mail from Washington addressed to NURDC, and I replied from the Naval Undersea Center. That went on for over a year. They finally said, 'Well, hell ...' and they got it changed."***



*$C^3$ SITE, Building 600, Seaside.*

## *San Diego: Toward Merger*

The technical departments of NELC and NUC shared work in fields as varied as signal processing, display technology, undersea optics, and many aspects of microprocessors. Beginning in 1973, representatives from the two centers met regularly to explore areas in which consolidations could reduce overhead. As the Vietnam War wound down, the defense budget, including its R&D portions, received careful scrutiny. Consequently, activities such as NELC and NUC were required to reduce costs.

Following the 1973 DoD Shore Establishment Realignment program, NUC Pasadena was disestablished on 3 May 1974. Special technical facilities, offices, and shops were transferred to San Diego along with direct functions and personnel. This transfer resulted from an overall reduction in the Naval Shore Establishment.

### Mission Areas

In 1975, NELC was chartered to be the Navy's principal RDT&E center for "electronics technology and command control and communications concepts and systems." In reality, NELC shared these missions to a considerable extent with the Naval Research Laboratory. To some in the Navy and Congress, this overlap suggested a wasteful duplication of effort. One major difference between NELC and NRL, however, was the greater emphasis at NRL on basic research and the greater emphasis at NELC on direct fleet support. The NELC emphasis was on short-term projects that were directly relevant to identified Navy needs and that would quickly benefit the Fleet. Basic research and development continued in areas most closely linked with the Center's major missions, namely electronic materials and electromagnetic propagation.

In 1972, NUC's role in undersea surveillance was expanded and NUC was chartered to be the Navy's principal RDT&E center for undersea surveillance, ocean technology, and advanced undersea weapons systems.

### Evaluating the Laboratories

The major Point Loma laboratories, NELC, NUC, and the Navy Personnel Research and Development Center (NPRDC), received a high-level evaluation in 1975 by a task group appointed by CNM and the Assistant Secretary of the Navy for R&D. Mr. M. Goland, vice-chairman of the Naval Research Advisory Committee (NRAC), chaired a panel of five others, including representatives of ONR, NRL, and the major systems commands. The panel visited the three laboratories over a 4-month period. The Goland Report concluded that NELC's facilities were preventing it from fulfilling its mission responsibilities. Persistent hiring and promotion freezes were keeping the Center from attracting and retaining necessary personnel. The Goland Report estimated that NELC was approximately 100 professionals below strength if it were to fulfill its lead laboratory mission for command control and communications.

In late 1975, another panel, the "Lab X Task Group," studied the problem of mission overlap and high overhead. This panel proposed creating a full-spectrum laboratory, meaning that the laboratory would support work in every DoD funding category: basic research, exploratory development, fleet support, and in-service engineering. As originally proposed, "Lab X" would have consolidated virtually all NELC departments, apart from human factors engineering, and would have taken several divisions from NRL: electronic warfare, information sciences, radar, and space systems. The new Point Loma laboratory would be supported by the administrative infrastructure of both NELC and NUC. But the "Lab X" proposal involved too drastic a realignment of laboratories, and on further investigation, the Navy found that many of the proposed elements were already present on Point Loma.

In January 1976, H. Tyler Marcy, Assistant Secretary of the Navy for R&D, directed Captain Robert Gavazzi, Commanding Officer of NELC, to submit a plan for the consolidation of NELC and NUC. A panel, headed by Captain Gavazzi, spent a year examining the possible merger and reported in favor of doing so. Managers of both NELC and NUC agreed that merger would be desirable.

## Merging NELC and NUC

With the groundwork laid, the Navy was ready to merge the two laboratories. Unlike prior mergers and realignments, merging NELC and NUC would not mean moving facilities or families, always an expensive process. Nor would there be Congressional opposition (as from Pasadena congressmen), since no facilities would close. No land needed to be purchased nor environmental impact studies prepared.

The big problem in creating the new laboratory was how to integrate personnel from two very different organizations. To ease the transition, the merger plan established six directorates: one for support and five in the technical areas of marine sciences and technology, weapon systems, ocean surveillance, command control and communications, and engineering and computer sciences. Each directorate comprised several existing departments, some NELC, some NUC. To minimize disruption at the project level, the structure of divisions and branches remained intact for the immediate future.

The managers who were assigned to smooth the merger had to define the mission of the entire center broadly enough to include all the work areas of the two existing centers, but they also had to distinguish the consolidated thrust from other laboratories and still relate it to primary U.S. Navy missions. The designated name of the consolidated laboratory became the Naval Ocean Systems Center. Various issues were time-consuming and delicate. Personnel had to be reassigned; some people's responsibilities increased, other's diminished. The consolidation had four purposes:

- Produce broad-spectrum systems capability.
- Facilitate integration of intelligence, ocean surveillance, $C^3$, and undersea weapons in support of the Navy's Sea Control mission.
- Combine research and technology programs to provide increased flexibility and larger blocks of funds for broader and in-depth investigation.
- Provide savings realized by combining support functions and through joint facilities usage.

## *Naval Ocean Systems Center (NOSC)*

On 1 March 1977, NELC and NUC were consolidated as the Naval Ocean Systems Center (NOSC). NOSC's mission was to be the principal Navy RDT&E center for command control, communications, ocean surveillance, surface- and air-launched undersea weapon systems, and supporting technologies. NOSC was chartered to lead the Navy's R&D thrusts in the following areas: command, control, and communications; ocean surveillance; integration of multiplatform combat systems; deep-ocean engineering; surface ship ASW fire control; lightweight torpedoes; and environmental studies as they bore on ocean surveillance, communications, and command and control. The Technical Director of NUC, Dr. Howard Blood, became the Technical Director of NOSC. The Commander of NELC, Captain Gavazzi, took over as Commanding Officer of NOSC.

## *New Systems and Research*

### Fleet Satellite Communications

By the late 1970s, the Navy had communications systems that operated in the UHF, SHF, and EHF areas, and NELC played a critical part in each. Today, for general communications, the Navy relies on UHF fleet satellite communications systems (FLTSATCOM), which the Department of Defense approved as a development concept in 1971. Interim-use satellites were launched in 1976 and used until other FLTSATCOM satellites could be launched later in the decade. The FLTSATCOM system introduced, on a broad scale, the transmission of naval communications via satellite relay and the control of this transmission through automation. FLTSATCOM consists of several subsystems. NELC developed software for all FLTSATCOM Information Exchange Systems (IXSs) and designed and developed secure-voice interfaces. The secure-voice interfaces were developed to serve as a switchboard on which the operator could control secure-voice communications on three independent satellite channels.

Additionally, NELC experts in SHF radio designed the shipboard antennas and the control systems used in the terminals for the shipboard SHF Defense Satellite Communication System. The antennas enabled ships to track satellites during the roughest sea conditions and at the highest latitudes (an important advance, since most satellites orbit near the equator).

*Verdin/ISABPS. ISABPS provides on-line multichannel access to the Verdin transmitting system.*

## Integrated Submarine Automated Broadcast Processing System (ISABPS)

Early in 1973 it was recognized that two major systems, the Submarine Satellite Information Exchange System (SSIXS) and Verdin, being developed for fixed-transmitter, submarine broadcast communications, would not realize their full potential when interfaced via the manual torn-tape method. (Tape would have to be torn off a SSIXS receiver and manually fed into the Verdin transmitters.) NELC initiated a program, the Integrated Submarine Automated Broadcast Processing System (ISABPS), to serve as a redundant, computerized system that would handle multichannel and multiple-rate broadcasts as well as encrypted and special intelligence traffic. ISABPS was designed to receive and verify SSIXS message traffic; prioritize, store, and forward messages; and schedule broadcasts for fixed VLF/LF sites. ISABPS was installed at seven shore VLF/LF broadcast transmitter sites to provide global submarine broadcast coverage.

The Verdin/ISABPS program became one of the largest of its kind accepted by NELC/NOSC and had the unique characteristic of being the first program for which NELC/NOSC was assigned the role of life-cycle support activity.

## Integrated Refractive Effects Prediction System (IREPS)

Since the 1950s, NEL/NELC made significant advances in understanding, modeling, and predicting atmospheric effects on radio propagation. In 1973, a fleet-wide conference on the problems of refractivity was held in San Diego. One of the recommendations from this conference was the development of a shipboard assessment capability. NELC was tasked to do this and developed the Integrated Refractive Effects Prediction System (IREPS). With this system, operational commanders were able, for the first time, to properly assess and exploit the serious effects atmospheric refractivity has on sensor and weapon systems performance. IREPS acquired, converted, and interpreted refractivity data from the lower atmosphere and displayed their effects on specific sensor and weapon systems in near realtime. Refractivity assessment techniques developed prior to IREPS were either too complex or too cumbersome for tactical military applications.

IREPS was first tested aboard USS *Enterprise* (CVN 65) in 1976. Based on its success, the Fleet requested an immediate interim operational capability. NELC/NOSC responded by developing an interim IREPS, which was based on a commercially available programmable desktop calculator. Since the first installation aboard USS *Ranger* (CV 61) in 1978, IREPS has been used operationally on all deployed aircraft carriers, on selected other ships, and at numerous shore installations.

## Inverse Synthetic Aperture Radar (ISAR)

In the mid-1970s, NELC took up the problem of radar imaging of ships. The advantages of two-dimensional target images over simple blips on a screen are important to many Navy missions in which radar is involved, notably target identification, weapons targeting, and damage assessment. The NELC approach to such imaging was to take advantage of, rather than to correct for, the pitch, roll, and yaw of the ship target. The concept is the inverse of Synthetic Aperture Radar (SAR) in that needed view-angle rotation is

*IREPS aboard USS* Constellation *(CV 64).*

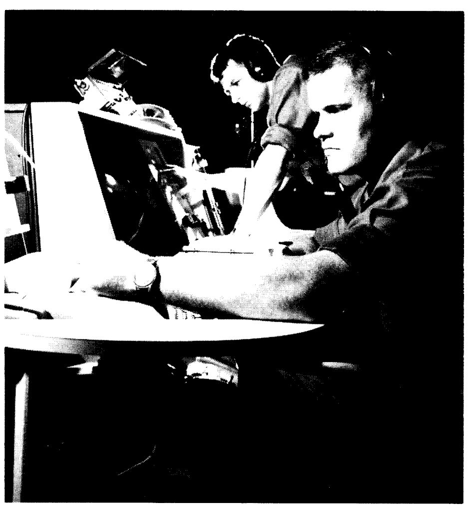
provided by the target instead of the radar platform—thus the name Inverse Synthetic Aperture Radar (ISAR). NELC obtained funding to test the ISAR concept against ship and air targets from a fixed shore site off Point Loma. In 1976, NELC succeeded in collecting the first images of ships. Later, NELC/NOSC demonstrated the feasibility of imaging air targets. The Navy's AN/APS-116 airborne antisubmarine warfare radar was then adapted for ISAR ship imaging by NRL under Project Profile. NELC had previously developed the pulse compression design to obtain high resolution in the AN/APS-116.

## Warfare Simulation, Evaluation, and Analysis

In the early 1960s, NOSC's predecessors designed and implemented the Naval Electronic Warfare Simulator (NEWS) for the Naval War College. This analog system enacted platform movements on a large screen and was replaced in the early 1970s by a digital system, the Warfare Analysis and Review System (WARS). In the early 1970s, NELC personnel designed and implemented the Tactical Warfare Analysis and Evaluation System (TWAES), a completely interactive realtime system that could be used as a command and control system for Marine Corps field exercises. Later called the Tactical Warfare Simulation, Evaluation, and Analysis System (TWSEAS), it could also be used as a stand-alone simulation system for Marine Corps $C^3$ system evaluation or training.

Upgraded and now known as the Marine air-ground task force Tactical Warfare Simulation System (MTWS), the computer-assisted war-gaming system simulates primary aspects of Marine Corps tactical operations, including air, ground, and amphibious operations. As a hardware/software system, MTWS provides realistic combat situations that stimulate a commander and the staff to perform normal command and control decision-making in a war game. NELC developed the original system in a rapid prototyping effort. Work began in 1971, and a limited operational system was functioning by 1973. The USMC took delivery of the first TWSEAS in 1978. At present, there are three MTWS sites: Fleet Marine Force Atlantic, Camp Lejeune, NC; Fleet Marine Force Pacific, Camp Pendleton, CA; and Marine Corps Development and Education Command, Quantico, VA.

The Warfare Environment Simulator (WES), designed and developed by NELC, performed the same functions for the Navy. WES was used by numerous Naval commands as a tool to assess $C^3$ systems, hypothetical strategies, tactics, weapon systems performance, and effectiveness of organizational structures. WES was a forerunner to the Interim Battle Group Tactical Trainer (IBGTT), which later dropped the "interim" from its name and added the new capabilities of the Research, Evaluation, and Systems Analysis (RESA) system.



*TWSEAS. A completely interactive realtime system, TWSEAS could be used as a $C^2$ system for field exercises, as well as a stand-alone simulation system for USMC $C^3$ system evaluation or training.*

## CURV III

On 7 March 1970, NASA launched a scientific payload to study the sun during a total eclipse. The payload, containing irreplaceable data films, was thought to be lost at sea when its recovery system malfunctioned.

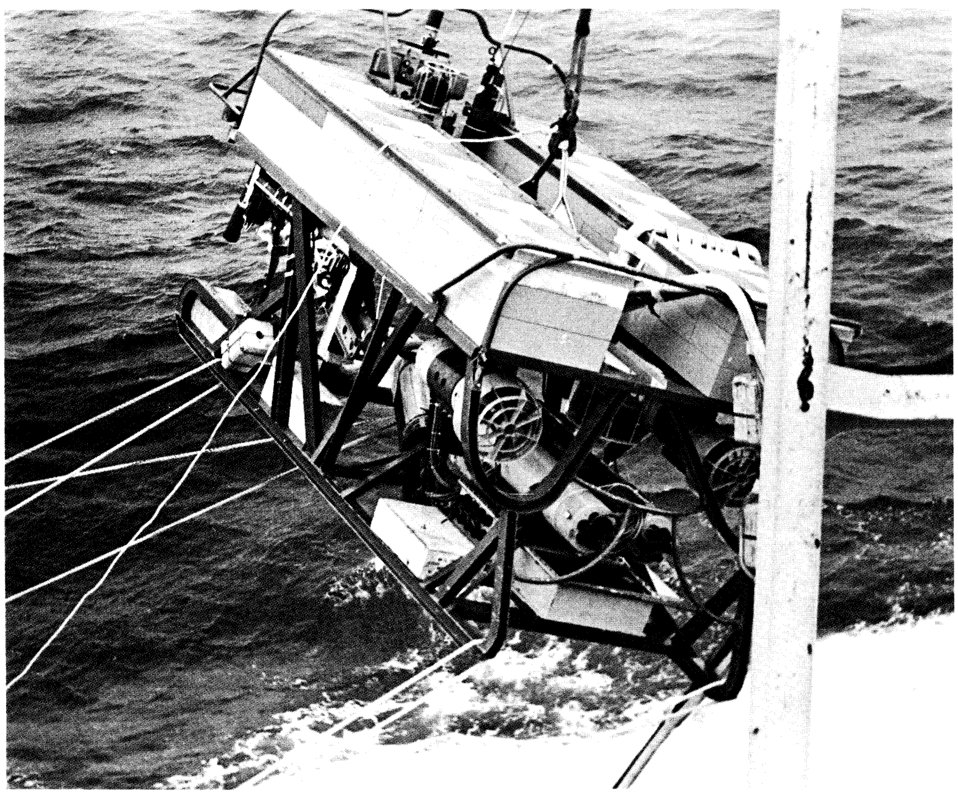
NURDC's CURV III was transported by C-141 aircraft from San Diego to Norfolk and placed aboard USS *Opportune* (ARS 41). Shallow test dives were conducted and operational and logistic plans were made. On 22 March, CURV III completed its search of the ocean floor 75 miles off the Virginia coast and successfully retrieved the payload from a depth of 5,800 feet.

The retrieved payload and its scientific data films were returned to NRL. Many of the films were processed successfully, and the results made a major contribution to understanding the solar corona and chromosphere.

In 1973, CURV played a vital role in a dramatic rescue of the Canadian submersible, *Pisces III*, whose two-man crew was trapped on the bottom of the Irish Sea at a depth of 1,375 feet. CURV III was flown to the scene, launched in heavy seas, and maneuvered into position to attach a recovery line. The recovery was made after *Pisces III* had been stranded for 3 days and as the air supply was nearly exhausted. Both men inside were safely rescued.

In 1976, CURV III assisted in the recovery of an F-14 lost in the North Sea. The aircraft rolled off the deck of USS *John F. Kennedy* (CV 67) and sank in more than 1,890 feet of water. Recovery operations were initiated because of concern that the Soviet Union would attempt to recover the F-14. Despite foul weather, the aircraft was recovered within 2 months.

*CURV III. Launching CURV III during* Pisces III *rescue operation.*




*Divers assist rescued pilots from* Pisces III.

## Remote Unmanned Work System (RUWS)

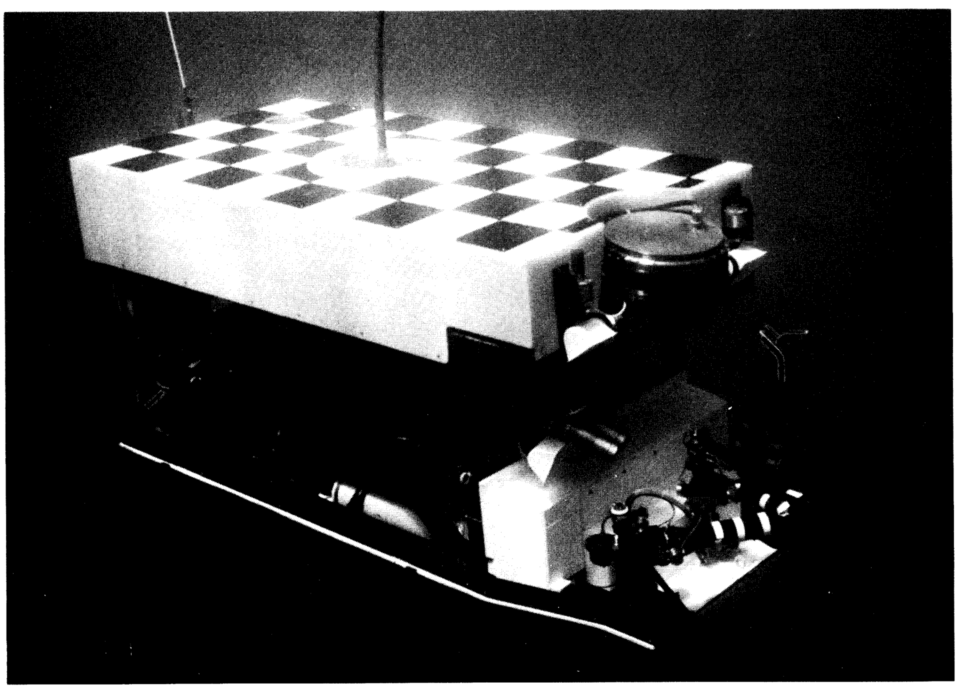
A key project at the Hawaii laboratory during the 1970s was a remote-controlled submersible system called the Remote Unmanned Work System (RUWS). A predecessor of the Advanced Tethered Vehicle (ATV) discussed in the next section, the RUWS project ran from 1974 to 1980. Similar to CURV in type, the vehicle was equipped with a 35-mm still camera, underwater light, and a pair of hydraulic manipulators designed to perform a variety of tasks. RUWS was a focal project under the Deep Ocean Technology program. The objective was to select missions for the development and demonstration of advanced technology that would then be applied to a variety of deep ocean programs. The prime missions selected for the RUWS technology program were recovery, repair, implantment, survey, documentation, and oceanographic data gathering. The objective was to provide a testbed whereby work capability could eventually be extended to 20,000 feet, which would thus provide access to 98 percent of the ocean floor.

RUWS was a pioneering effort that required advances in cable, connector, work systems, and telemetry technology. Developing a cable to take RUWS to great depths was the project's main stumbling block. RUWS became the first deep tethered vehicle to use a single electromechanical support cable and pioneered the use of Kevlar® as a strengthen member for such application. Kevlar has all the properties and the strength of steel and only one-seventh the weight. This fact is important when reeling out 20,000 feet of payload that then has to be lifted back.

Kevlar® is a registered trademark of Du Pont Chemical Company.

Concurrent with the development of RUWS, NUC/NOSC embarked on the development of a series of small, light-work and inspection vehicles for use in shallow waters. These "mini-CURVs" were needed for simpler, shallower tasks, for which the large CURV/RUWS-type machines proved too cumbersome or expensive. This work led to the development of the SNOOPY series of small remotely operated vehicles (ROVs).

*RUWS. The remote-controlled submersible was equipped with a 35-mm still camera, underwater light, and a pair of hydraulic manipulators designed to perform a variety of tasks.*



## Small-Waterplane-Area Twin Hull (SWATH) Ship

The concept of reducing waterplane area to reduce ship motions dates back to 1905. While early designs might have proved acceptable at low-to-moderate speeds, most designs tended to become dynamically unstable at the higher speeds (20 knots) of interest to the Navy. A solution to this instability problem was patented by Center engineer Dr. Thomas Lang in 1971. Subsequently, the Small-Waterplane-Area Twin Hull (SWATH) ship concept was used by a team of designers at the Hawaii laboratory and the Pearl Harbor Naval Shipyard to design and specify the semisubmerged platform SSP*Kaimalino*. Following a series of trials and modifications on the East Coast, *Kaimalino* was transported to Hawaii where it since logged thousands of hours at sea in support of Navy operations.

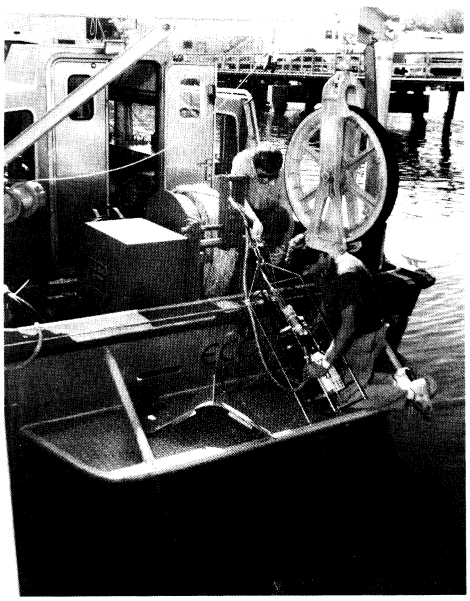
*SSP* Kaimalino. *The 88-foot-long, twin-hulled* Kaimalino *serves as a range support surface craft capable of operating in high sea states.*

## Environmental Sciences

Biological and chemical studies of the marine environment began at NUC in 1971 when CNM delegated to NUC primary responsibility for inshore and nearshore marine environment studies. NUC's study of Pearl Harbor won the Center, in 1972, the Navy's first Environmental Protection Award. Much of the Center's work in environmental assessment has involved and continues to involve the methods and techniques necessary to measure the effects on the environment of different kinds of stresses (noise, chemicals, and heat) and to research the impacts of such Navy-specific activities as dredging and in-water hull cleaning.

Starting in 1974, NUC environmental biologists and chemists working at Kaneohe Bay, Oahu, Hawaii, developed a sophisticated laboratory at the foot of the extinct Ulupau volcano to measure the effects of the Navy's presence in environmentally sensitive harbors. The Ulupau Microcosm Facility consists of a series of tanks that can replicate both a given environment and its biology by recruiting the larvae of organisms native to it. This facility continues to perform countless environmental assessments for the Navy.

In 1976, the Marine Environmental Quality Assessment (MEQA) program was begun to consolidate separate efforts into a cohesive program. The general objective was to develop the technology necessary to assess scientifically the effects of naval facilities and operations on the marine environment. Since the methods used to study dynamic environments such as harbors and estuaries must be able to account for temporal and spatial variabilities, the emphasis was placed on multivariate, realtime systems. Such systems must also distinguish between Navy and non-Navy sources of environmental stress.



*Scientists configuring a new MESC for measurement of pollutants in Navy harbors and bays. (1989 photo)*

In 1978, NOSC began work on a field survey that combined as many relevant measurement systems as practicable for the conduct of multivariate, realtime surveys. This system enabled researchers to understand spatial (and temporal) variabilities and relationships among various environmental parameters. Physically, the field survey system was located in a dedicated Marine Environmental Survey Craft (MESC), a converted houseboat equipped with sensors and processing equipment. NOSC also developed a portable, modular version of the MESC systems, including the Realtime Data Analysis System, a transportable, microcomputer-based assessment system normally installed on a survey platform vessel. The MESC surveyed the Navy's *Trident* submarine base at Kings Bay, GA, as well as the harbors of San Diego, CA; Norfolk, VA; Charleston, SC; and Pearl Harbor, HI.

The MEQA program provided direct assistance to the Fleet on environmental problems. Specific issues ranged from consulting with naval stations and engineering field divisions, to writing environmental impact statements, to conducting a comprehensive study of the environmental impacts of in-water hull cleaning. Further environment studies have been possible, in large measure, because of the technologies originally developed in the MEQA program.

## Undersea Surveillance

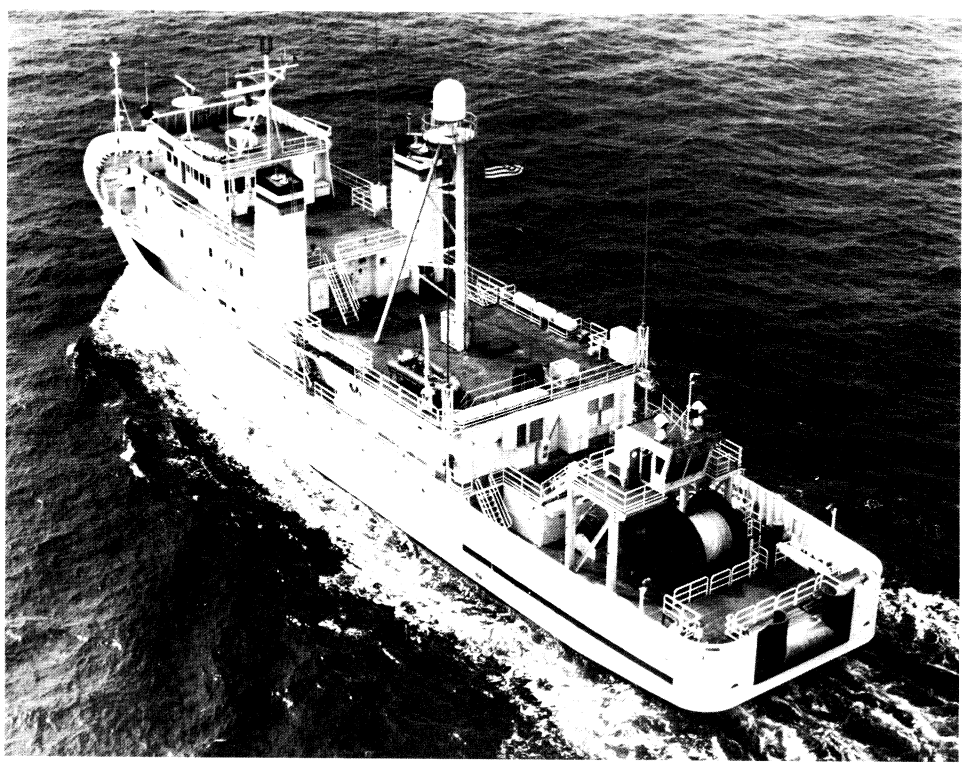
In 1970, NURDC took over responsibility for the new field of undersea surveillance, essentially the long-range detection and monitoring of submarines. Detecting submarines was an old problem, but since 1945, submarines had grown quieter, faster, and more numerous. Submarines no longer had to run on the surface to recharge their batteries. Thus, the chances for radar to detect submarines dropped significantly, and acoustics became an even more important means of detection.

By 1970, the Navy's undersea surveillance capabilities consisted of arrays of hydrophones of the Sound Surveillance Underwater System (SOSUS) cabled to shore-to-shore processing stations. To combat the trends of increasing ambient noise in the ocean and quieter Soviet submarines, the U.S. Navy developed a program to enhance the shore processing capabilities of SOSUS by adding modern digital signal processing, communications, and information-processing systems. NUC and later NOSC have been involved in the development, installation, and performance analysis of the enhancements to the computer-based subsystems for SOSUS. These upgrades, collectively defined as the SOSUS Phase I and Phase II Backfit Programs, have given the U.S. Navy an increased capability to locate and localize Soviet submarines.

In the early 1970s, Hank Aurand (then at NAVMAT but shortly thereafter at NUC) proposed that a valuable adjunct to the SOSUS system would be a mobile SOSUS that could replace a disabled SOSUS array or could provide surveillance in waters far from the fixed SOSUS arrays. NUC demonstrated that the idea was feasible with the Large Aperture Marine Basic Data Array (LAMBDA). LAMBDA adapted commercial geophysical exploration equipment from offshore workboats to establish both a database and operational procedures.

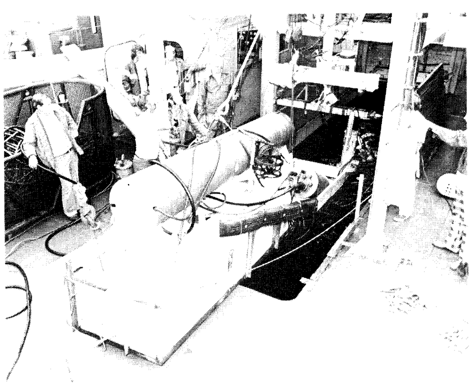
This work and a series of towed array projects at NUC/NOSC led to the development of the mobile SOSUS-like towed array called the Surveillance Towed Array Sensor System (SURTASS). SURTASS was designed to be a long-range passive receiver operated from special ships dedicated exclusively to the system. These ships, known as the T-AGOS class, not only towed the array but housed data-processing equipment to distinguish signals from background noise. Moreover, T-AGOS ships could relay their data to shore processing facilities by using satellite communications links, also developed at NOSC. The shore sites could correlate the data with information developed from other T-AGOS ships, SOSUS arrays, tactical sonars, or other sources. SURTASS passed both its technical and operational evaluations in 1980. Several SURTASS T-AGOS ships have since been delivered to the Fleet, and SURTASS is revolutionizing undersea surveillance.

*USNS* Stalwart *(T-AGOS).* Stalwart *was the first ship equipped with SURTASS and used for flexible, worldwide, long-range acoustic surveillance.*

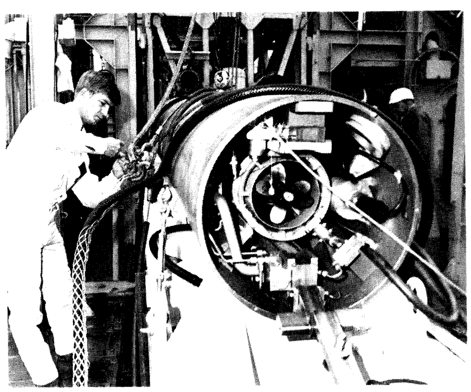


## Mobile Submarine Simulator (MOSS)

Beginning in 1972, NUC updated a sound beacon concept developed by NEL during World War II. Sound beacons were decoys that submarines could launch to baffle enemy sonars. NUC's Mobile Submarine Simulator (MOSS) was a torpedo-tube-launched, self-propelled decoy. The strategic objective behind MOSS was to enhance the security of the Navy's ballistic missile submarines by preventing them from being detected and tracked. Operational evaluation of the system exceeded all established goals, and the MOSS system became an integral part of all fleet ballistic missile and *Trident* submarine defensive weapon systems.



*Testing of NUC's MOSS, a torpedo-tube-launched, self-propelled decoy.*



*MOSS propulsion system.*

## Torpedoes Mk 46 and Mk 50

Early in the 1970s, the Navy recognized that Soviet submarines were making rapid technological progress. Against faster and quieter targets, the existing Mk 46 lightweight torpedo would be less effective.

In 1975, NUC was designated lead laboratory for the new Advanced Lightweight Torpedo, Mk 50. This next-generation torpedo is designed to run faster and deeper and with greater detection range than the Mk 46. (The Mk 50 will be discussed further in the next section.)

The laboratory continued to support and enhance the Mk 46 torpedo in the parallel Near Term Improvement Program (NEARTIP). NEARTIP lasted from 1974 to 1977 and developed new electronics for the Mk 46, which today remains in service with the Fleet and with various Allied navies.